METHOD FOR CONNECTING TERMINAL DEVICES TO EXTERNAL MODEMS

The invention is directed in general to a method for connecting terminal devices ~~an~~ modems and, stated more specifically, to a method for connecting terminal devices to external modems via local networks (LAN).

ADSL (or, generally, xDSL) modems will enable significantly faster Internet access in future compared to current modems. Similar to current analog modems, there will also be two versions for xDSL modems: external modems in their own housing that are connected via cable to the terminal device (client) as well as internal modems that are either permanently installed in the terminal device or are in the form of ~~plug-in~~ cards that can also be subsequently installed.

External modems must be connected to the terminal device via corresponding interfaces, whereby what is referred to as the Ethernet is especially well-suited because of the high bandwidth and the low costs. Ethernet thereby has the advantage that a plurality of terminal devices can access one or more modems via a local network. This constellation is especially interesting, for example, in networks in small companies.

However, Ethernet as interface between terminal device and modem has the disadvantage that the conversion of the data packets (PPP packets) that are exchanged via the modem path onto the local network (LAN) is very involved.

For this purpose, T. Kwok et al., "An Interoperable End-to-end Broadband Service Architecture over ADSL Systems (Version 3.0)", ADSL Forum Contribution 97215, December 1997, proposes the employment of a future standard protocol (layer 2 tunneling protocol) with whose assistance PPP packets can be transmitted via the local network upon employment of UDP/IP. This solution, however, has a number of disadvantages:

1. The protocol known from the Prior Art is very complex and makes high demands of the modem.
2. The proposed protocol offers many functions that are not used for the application in the sense of the present invention.

3. The protocol requires the prior configuration of the IP addresses of terminal device (client) and modem. This, however, is very involved. What would be desirable, in contrast, is a plug-and-play configuration without prior configuration on the part of the user.

4. A direct control of the modem parameters is not possible.

The object of the present invention is therefore to avoid the aforementioned disadvantages of the Prior Art and to offer a technique for connecting terminal devices and modems via local networks that is particularly user friendly.

According to the present invention, a method for connecting terminal devices to external modems is provided therefor wherein a plurality of modems can enter into communication with the terminal devices with a local network. A number of steps are implemented between one of the plurality of terminal devices and one of the modems for the connection setup. First, a search request is sent from the corresponding terminal device to all modems that are connected to the local network. Those modems that have free resources respond with a reply to the inquiring terminal device. The terminal device subsequently makes a selection from the modem that sent a reply, and a connection setup ensues proceeding from the terminal device to the selected modem by exchanging control information.

The external modems can, in particular, be ADSL modems.

The local network can, in particular, be an Ethernet network.

Information for the connection setup and for setting the external modems can be exchanged between the terminal devices and the external modems via an integrated control channel.

The search request can contain further particulars about the required bandwidth and/or the required protocol, whereby only those external modems that can meet all requirements according to the further particulars reply to a search request.

Proceeding from the terminal device, settings of the modem can be implemented via an integrated control channel.

For flow control of the transmitted data, the respectively receiving terminal device or modem can output start/stop commands with which the data

transmission of the respectively transmitting terminal device or modem can be started or, respectively, stopped.

After the connection setup, echo data that make it possible for the modem to recognize whether the terminal device is active can be exchanged at periodic intervals.

The connection between the modem and the terminal device can be automatically cleared down after a predetermined time when the modem or the terminal device has received none of the echo data during this predetermined time.

For connection cleardown, cleardown ~~dat~~ data can be exchanged between the terminal device and the modem, whereby the resources of the connection are in turn released after the cleardown of the connection.

The present invention is explained in greater detail below on the basis of an exemplary embodiment and with reference to the accompanying Figures. ~~SHown are~~:

Figure 1 is a block diagram showing the schematic structure of a system for the employment of the inventive method; and

Figure 2 is a chart showing the executive sequence of the method for the setup of a connection from a terminal device to a modem via a local network.

Figure 1 shows two ADSL modems 3, 4 by way of example that can set up a connection between an ADSL line 5 and a local network, for example an Ethernet LAN 6. The ADSL modems 3, 4 can be connected to terminal devices (client) 1, 2 with the Ethernet LAN 6.

The method for the setup of a connection between a terminal device 1, 2 and a modem 3, 4 via the Ethernet interface 6 thereby sequences as follows:

Phase 1: Seeking the modem (modems) (steps S1, S2)

The searching terminal device 1, 2 sends a search request (modem request) to all ADSL modems 3, 4 attached to the Ethernet LAN network 6. A specific address is employed for this purpose (also called "limited broadcast address" 255.255.255.255 in IP networks), this ~~leading thereto that~~ leads to the packet of the search ~~request is received by all modems 3, 4~~ at the connected Ethernet segment. All

modems 3, 4 that support the protocol described here and have free resources over and above this, send a reply (modem reply). The terminal device 1, 2 receives all replies and is thus informed about all modems that still have free resources. Subsequently, the terminal device 1, 2 can select one of the available modems 3, 4.

Phase 2: Connection setup (steps S5, ~~S6 [sic]~~).

The terminal device now initiates a connection setup with the selected modem. Specific control packets (connect request, connect confirm) are exchanged for this purpose, these ultimately leading to a communication relationship (logical connection) between terminal device and modem. Each side thereby assigns a number (session ID) that, in conjunction with the IP address, unambiguously identifies the communication relationship. Both numbers are contained in all following packets of the connection.

Phase 3: Control of the modem (steps S5, S6)

In general, the terminal device now sends various control commands to the modem (similar to current, analog modems). Among other things, the modem can be informed of the destination telephone number to which a connection is to be set up. Moreover, various modem parameters can be influenced such as, for example, bit rate, compression method, error correction, etc. These control commands are based on the commands for analog modems but can also contain specific expansions for xDSL.

Phase 4: Data exchange (steps S7, S8)

When all settings have been made, the actual data exchange can begin, i.e. PPP packets can be sent bidirectionally via the connection between modem and terminal device. So that the reception buffers at both sides do not overflow, a flow control is provided according to the start/stop principle. Each receiver can thus stop the transmitter of the cooperating party by sending a stop command and can restart it in turn with a start command. Moreover, the connection can, if desired, be monitored from both sides by periodic transmission of echo packets. As a result thereof, the

modem can recognize when the terminal device no longer reacts or has been switched off.

Phase 5: Connection cleardown (steps S9 and S10)

In this phase, the connection between the terminal device and the modem is cleared down in a controlled fashion. To that end, further control packets (release request, release confirm) are exchanged that ultimately lead to the release of the occupied resources.

Message flow

Figure 2 shows the typical message flow between the terminal device and the modem, beginning with the search phase (search request) up to ~~an including~~ and including the end of the connection. The individual messages exchanged between the terminal device and the modem or, respectively, vice versa are described in brief below.

Modem request (step S1)

This message is sent in order to find all modems connected to an Ethernet segment. The message is sent to all stations and, in addition to containing the layer-3 address of the searching terminal device, potentially contains further information such as user name, the desired bandwidth, the desired protocol, etc. These information can be interpreted by the modems, so that only those modems that can meet all requested demands reply.

Modem reply (step S2)

All suitable modems reply with this message and thus inform the terminal device of their own layer-3 address. This message is sent directly to the terminal device (no broadcast).

Connect request (step S3)

After the terminal device has selected one of the modems, the connection setup is started proceeding from the terminal device. To this end, the terminal device

sends a connect request message to the selected modem. The parameters contained in the modem request message should be repeated in this message and further parameters should be added, if necessary. The terminal device already assigns a session ID in order to enable an unambiguous allocation of the reply of the modem.

Connect reply (step S4)

The modem replies with a connect reply message that also contains its own session ID in addition to the session ID assigned by the terminal device. This message tells the terminal device whether the requested connection was accepted or refused. In case of an acceptance, the connection is in place and each side knows the session ID assigned by the other side, this being contained in all further messages. Given a refusal, the connection is cleared down from both sides.

Control (step S5)

Control commands can now be sent to the modem via the existing connection, similar to the case given analog modems. For example, the terminal device can interrogate various modem parameters such as type, the maximum bit rate, the dial capability, the ATM traffic classes that are supported, etc. The terminal device can also potentially influence some modem parameters and can initiate the setup of a dialed connection. In addition to the telephone number, other parameters that are required for the connection setup can also be indicated (for example, the ATM traffic class and the appertaining parameters such as peak bit rate and the like).

ControlAck (step S6)

Each control command is acknowledged by a separate message that can also contain the reply of the modem.

PayloadPacket (steps S7, S8)

This message contains the actual payload data, It can be sent in both directions between terminal device and modem. Payload data are transmitted

unprotected; the loss of payload data can therefore not be recognized within the protocol described here.

Stop

This message can be sent in order to avoid the overflow of the proper reception buffer. When a stop message is received, payload data are no longer sent in the opposite direction until a start message is received.

Start

See above.

Echo request

This message is employed in order to check the availability and functionability of the respective cooperating party during an active connection. When an echo request is not answered with an echo reply message within a specific time span, the connection can be cleared down. For example, this mechanism allows the modem to clear down all active network connections when the terminal device was switched off without clearing the connection down in controlled fashion.

Echo reply

The reception of an echo request message is immediately acknowledged with an echo reply message. As a result thereof, the cooperating party is assured that the connection is still active.

Release request (step S9)

This message can be sent from both sides and serves the purpose of clearing down an existing connection. The reception of a release request message is acknowledged with a release confirm message by the cooperating party.

Release confirm

See release request.

Advantages of the disclosed method

The invention has the following advantages over the known methods:

- No modem-specific data need be configured in the terminal device. The layer-3 address of the modem is determined by the method, and further modem parameters can also be automatically determined by the terminal device without a need for the user to intervene. A simple installation without specific technical expertise is thus enabled (plug-and-play).
- The method enables the direct control of the modem via an integrated control channel. As a result thereof, modem commands can be communicated like via a serial interface.
- The proposed method is significantly simpler to realize.

Possible expansions

The described method assumes that the terminal device already has a functioning Ethernet interface and an appertaining layer-3 address (for example, IP) address available to it. In order to likewise avoid this configuration event and enable a completely independent auto-configuration, the disclosed method can be combined with further protocols such as BOOTP or DHCP. To this end, the modem functions as a simple BOOTP (DHCP) server from which the terminal device can receive its configuration data. The configuration data (essentially the layer-3 address and a few other parameters such as sub-network mask) must be offered on the modem for this purpose. This can be carrier out by the manufacturer or by the network operator. The driver SW (software) of the terminal device should be pre-set such that an automatic configuration ensues via BOOTP (DHCP) as well as with the method described here. Any and all user-side configuration is avoided in this way.

The disclosed method can also be expanded in that the search message (modem request) is transported across routers (similar to a BOOTP/DHCP proxy). As a result thereof, modems that are not directly connected to the local Ethernet segment but can only be reached via routers can also be found in larger networks. To this end, the router must contain a proxy function that forwards the sub-message to all connected Ethernet segments (or, respectively, to all segments that support broadcast).

The following advantages can, in particular, be realized by the present invention:

1. In the introduction of the automatic search event with whose assistance all connected modems can be automatically recognized.
2. In the introduction of a separate control channel via which the modem can be configured and controlled.
3. In the employment of a simple method for flow control between terminal device and modem.
4. In the combination with BOOTP or DHCP, as a result whereof a complete auto-configuration is enabled.